Appl. No. 10/623,191
Amendment Dated July 21, 2008
Reply to Final Office Action of December 17, 2007

Dkt. R-232

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1.   (Currently Amended) A method for grayscale registration of a first medical image and a second medical image, comprising the steps of:

spatially registering the first medical image and the second medical image relative to each other;

generating at least one joint pixel value histogram based on pixel values of the first and second medical images;

generating a lookup table based at least in part on the at least one joint pixel value histogram, a first image acquisition method for the first medical image and a second image acquisition method for the second medical image; and

applying the lookup table to the pixel values of the first medical image to generate a third medical image, the third medical image being transformed from the first medical image and registered to the second medical image;

wherein the step of generating the lookup table includes:

selecting a parametric transform function from a plurality of predetermined, parametric transform functions based on the first and second medical image acquisition methods for the first and second medical images, respectively; and

statistically fitting parameters of the selected parametric transform function to the at least one pixel value histogram, the statistically fitting determines values of the parameters, wherein the lookup table is generated using the selected parametric transform function and the values of the fitted parameters;

Appl. No. 10/623,191
Amendment Dated July 21, 2008
Reply to Final Office Action of December 17, 2007

Dkt. R-232

and wherein each of the first and second medical images is one of a digitized analog image and a digitally acquired image and wherein the plurality of predetermined parametric transform functions includes: (1) a function for registering a digitized analog image to another digitized analog image, (2) a function for registering a digitally acquired image to another digitally acquired image, (3) a function for registering a digitally acquired image to a digitized analog image, and (4) a function for registering a digitized analog image to a digitally acquired image.

2.   Canceled.

3.   Canceled.

4.   (Currently Amended) The method of claim [[3]] 1, wherein the plurality of predetermined parametric transform functions are one-dimensional monotonic functions.

5.   Canceled.

6.   (Currently Amended) The method of claim [[3]] 1, wherein each of the plurality of predetermined parametric transform functions models image acquisition parameters, the image acquisition parameters being at least one of incident radiation intensity, exposure time, film characteristic curve for an analog image, digitizer characteristic for digitizing an analog image, and digital detector response for a digitally acquired image.

Appl. No. 10/623,191
Amendment Dated July 21, 2008
Reply to Final Office Action of December 17, 2007

Dkt. R-232

7.   (Currently Amended) The method of claim [[3]] 1 , wherein each of the first and second medical images is a mammogram, and wherein each of the plurality of predetermined parametric transform functions models image acquisition parameters, the image acquisition parameters being at least one of breast thickness, incident radiation intensity, exposure time, film characteristic curve for an analog image, digitizer characteristic for digitizing an analog image, and digital detector response for a digitally acquired image.

8.   (Original) The method of claim 1, further comprising the steps of:
        performing computer aided detection process for comparing the second and third medical images; and
        displaying the second and third medical images with results of said computer aided detection process.

9.   (Original) The method of claim 1, wherein spatially registering the first and second medical images includes at least one of translating, rotating, shearing and scaling at least one of the first and second medical images.

10.   (Original) The method of claim 1, wherein each of the first and second medical images includes a target portion and a remainder portion and wherein spatially registering the first and second medical images includes segmenting the target portion and the remainder portion of each of the first and second medical images.

11.   (Original) The method of claim 1, wherein each of the first and second medical images includes a target portion and a remainder portion and wherein spatially registering the first and second medical images includes cropping each of the first and second medical images to contain only the target portion that is in both the first and second medical images.

Appl. No. 10/623,191
Amendment Dated July 21, 2008
Reply to Final Office Action of December 17, 2007

Dkt. R-232

12. (Original) The method of claim 11, wherein the at least one pixel value histogram is generated based on pixel values of only the cropped first and second medical images.

13. (Original) The method of claim 1, wherein spatially registering the first and second medical images includes optimization of an entropy correlation coefficient of the first and second medical images.

14. (Currently Amended) A method for registering a first medical image to a second medical image, comprising the steps of:

generating a joint pixel value histogram using pixel values of the first and second medical images;

selecting a parametric transform function from a plurality of predetermined parametric transform functions, the selecting being based on a first medical image acquisition method for the first medical image and a second medical image acquisition method for the second medical image; and

statistically fitting parameters of the selected parametric transform function to the joint pixel value histogram, the statistically fitting determines values of the parameters;

wherein each of the first and second medical images is one of a digitized analog image and a digitally acquired image and wherein the plurality of predetermined parametric transform functions includes: (1) a function for registering a digitized analog image to another digitized analog image, (2) a function for registering a digitally acquired image to another digitally acquired image, (3) a function for registering a digitally acquired image to a digitized analog image, and (4) a function for registering a digitized analog image to a digitally acquired image.

Appl. No. 10/623,191
Amendment Dated July 21, 2008
Reply to Final Office Action of December 17, 2007

Dkt. R-232

15. (Original) The method of claim 14, further comprising:

generating a lookup table using the selected parametric transform function and the values of the fitted parameters; and

applying the lookup table to the pixel values of the first medical image to generate a third medical image, the third medical image being transformed from the first medical image and registered to the second medical image.

16. (Original) The method of claim 14, further comprising the steps of:

performing computer aided detection process for comparing the second and third medical images; and

displaying the second and third medical images with results of said computer aided detection process.

17. (Original) The method of claim 14, wherein the plurality of predetermined parametric transform functions are one-dimensional monotonic functions.

18. Canceled.

19. (Original) The method of claim 14, wherein each of the plurality of predetermined parametric transform functions models image acquisition parameters, the image acquisition parameters being at least one of incident radiation intensity, exposure time, film characteristic curve for an analog image, digitizer characteristic for digitizing an analog image, and digital detector response for a digitally acquired image.

Appl. No. 10/623,191
Amendment Dated July 21, 2008
Reply to Final Office Action of December 17, 2007

Dkt. R-232

20.　(Original)　The method of claim 14, wherein each of the first and second medical images is a mammogram, and wherein each of the plurality of predetermined parametric transform functions models image acquisition parameters, the image acquisition parameters being at least one of breast thickness, incident radiation intensity, exposure time, film characteristic curve for an analog image, digitizer characteristic for digitizing an analog image, and digital detector response for a digitally acquired image.

21.　(Original)　The method of claim 14, further comprising spatially registering the first medical image and the second medical image relative to each other.

22.　(Original)　The method of claim 21, wherein spatially registering the first and second medical images includes at least one of translating, rotating, shearing and scaling at least one of the first and second medical images.

23.　(Original)　The method of claim 21, wherein each of the first and second medical images includes a target portion and a remainder portion and wherein spatially registering the first and second medical images includes segmenting the target portion and the remainder portion of each of the first and second medical images.

24.　(Original)　The method of claim 21, wherein each of the first and second medical images includes a target portion and a remainder portion and wherein spatially registering the first and second medical images includes cropping each of the first and second medical images to contain only the target portion that is in both the first and second medical images.

25.　(Original)　The method of claim 24, wherein the joint pixel value histogram is genera ted based on pixel values of only the cropped first and second medical images.

Appl. No. 10/623,191
Amendment Dated July 21, 2008
Reply to Final Office Action of December 17, 2007

Dkt. R-232

26. (Original) The method of claim 21, wherein spatially registering the first and second medical images includes optimization of an entropy correlation coefficient of the medical images.

27. (Currently Amended) A system for registering a first medical image to a second medical image, comprising:

an input for receiving data for the first and second medical images; and

a processor configured to generate a joint pixel value histogram using pixel values of the first and second medical images, select a parametric transform function from a plurality of predetermined parametric transform functions based on a first image acquisition method for the first medical image and a second image acquisition method for the second medical image, and statistically fit parameters of the selected parametric transform function to the joint histogram to determine the values of the parameters;

wherein each of the first and second medical images is one of a digitized analog image and a digitally acquired image, and wherein the plurality of predetermined parametric transform functions includes: (1) a function for registering a digitized analog image to another digitized analog image, (2) a function for registering a digitally acquired image to another digitally acquired image, (3) a function for registering a digitally acquired image to a digitized analog image, and (4) a function for registering a digitized analog image to a digitally acquired image.

28. (Original) The system of claim 27, wherein the processor is further configured to generate a lookup table using the selected parametric transform function and the values of the fitted parameters and to apply the lookup table to the pixel values of the first medical image to generate a third medical image, the third medical image being transformed from the first medical image and registered to the second medical image.

Appl. No. 10/623,191
Amendment Dated July 21, 2008
Reply to Final Office Action of December 17, 2007

Dkt. R-232

29. (Original) The system of claim 27, wherein the processor is further configured to perform a computer aided detection process for comparing the second and third medical images, the system further comprising:

a display for displaying the second and third medical images with results of the computer aided detection process.

30. (Original) The system of claim 27, wherein the plurality of predetermined parametric transform functions are one-dimensional monotonic functions.

31. Canceled.

32. (Original) The system of claim 27, wherein each of the plurality of predetermined parametric transform functions models image acquisition parameters, the image acquisition parameters being at least one of incident radiation intensity, exposure time, film characteristic curve for an analog image, digitizer characteristic for digitizing an analog image, and digital detector response for a digitally acquired image.

33. (Original) The system of claim 27, wherein the processor is further configured to spatially register the first medical image and the second medical image relative to each other.

34. (Original) The system of claim 33, wherein the processor is further configured to spatially register the first and second medical images by at least one of translating, rotating, shearing and scaling at least one of the first and second medical images.

Appl. No. 10/623,191
Amendment Dated July 21, 2008
Reply to Final Office Action of December 17, 2007

Dkt. R-232

35.   (Original) The system of claim 33, wherein each of the first and second medical image includes a target portion and a remainder portion and wherein the processor spatially registers the first and second medical images by segmenting the target portion and the remainder portion of each of the first and second medical images.

36.   (Original) The system of claim 33, wherein each of the first and second medical images includes a target portion and a remainder portion and wherein the processor is further configured to crop each of the first and second medical images to contain only the target portion that is in both the first and second medical images.

37.   (Original) The system of claim 36, wherein the processor is further configured to generated the joint pixel value histogram based on pixel values of only the cropped first and second medical images.

38.   (Original) The system of claim 33, wherein the processor is further configured to spatially register the first and second medical images by optimizing an entropy correlation coefficient of the first and second medical images.

39.   (Currently Amended) A <u>computer readable medium embodied with a</u> computer program product <u>such that when executed directs</u> ~~embodied on a computer-readable medium for directing~~ a computing apparatus to automatically register a first medical image and a second medical image, comprising:

computer code for generating a joint pixel value histogram using pixel values of the first and second medical images;

computer code for selecting a parametric transform function from a plurality of predetermined parametric transform functions, the selecting being based on a first image acquisition method for the first medical image and a second image acquisition method for the second medical image; and

Appl. No. 10/623,191
Amendment Dated July 21, 2008
Reply to Final Office Action of December 17, 2007

Dkt. R-232

computer code for statistically fitting parameters of the selected parametric transform function to the joint pixel value histogram, the statistically fitting determines values of the parameters, wherein each of the first and second medical images is one of a digitized analog image and a digitally acquired image and wherein the plurality of predetermined parametric transform functions includes: (1) a function for registering a digitized analog image to another digitized analog image, (2) a function for registering a digitally acquired image to another digitally acquired image, (3) a function for registering a digitally acquired image to a digitized analog image, and (4) a function for registering a digitized analog image to a digitally acquired image.

40.   (Currently Amended) A computer readable medium embodied with a computer program product such that when executed directs ~~embodied on a computer-readable medium for directing~~ a computing apparatus to automatically register a first medical image and a second medical image, comprising:

computer code for spatially registering the first medical image and the second medical image relative to each other;

computer code for generating at least one joint pixel value histogram based on pixel values of the first and second medical images;

computer code for generating a lookup table based on the at least one joint pixel value histogram, a first image acquisition method for the first medical image and a second image acquisition method for the second medical image; and
computer code for applying the lookup table to the pixel values of the first medical image to generate a third medical image, the third medical image being transformed from the first medical image and registered to the second medical image:

wherein the computer code for generating the lookup table includes:

computer code for selecting a parametric transform function from a plurality of predetermined, parametric transform functions based on the first and second medical image acquisition methods for the first and second medical images, respectively; and

computer code for statistically fitting parameters of the
selected parametric transform function to the at least one pixel
value histogram, the statistically fitting determines values of the
parameters, wherein the lookup table is generated using the
selected parametric transform function and the values of the fitted
parameters;

wherein each of the first and second medical images is one of a digitized
analog image and a digitally acquired image, and wherein the plurality of predetermined
parametric transform functions includes: (1) a function for registering a digitized analog
image to another digitized analog image, (2) a function for registering a digitally
acquired image to another digitally acquired image, (3) a function for registering a
digitally acquired image to a digitized analog image, and (4) a function for registering a
digitized analog image to a digitally acquired image.